# Characteristics of Older Pedestrians Who Have Difficulty Crossing the Street


## ABSTRACT

*Objectives.* This study examined the sociodemographic and health characteristics and problems of older pedestrians.

*Methods.* Interviews and assessments were conducted with 1249 enrollees aged 72 or older from the New Haven, Conn, community of the Established Populations for Epidemiologic Studies of the Elderly who agreed to participate in a seventh follow-up.

*Results.* Approximately 11% of the New Haven residents reported difficulty crossing the street. Older pedestrians needing help in one or more activities of daily living were more than 10 times as likely as others, and those with the slowest walking speeds were nearly 3 times as likely as others, to report difficulty crossing the street. Fewer than 1% of these pedestrians aged 72 or older had a normal walking speed sufficient to cross the street in the time typically allotted at signalized intersections (1.22 m/sec).

*Conclusions.* Crossing times at signalized intersections in areas with large populations of elders should be extended, and the recommended walking speed for timing signalized crossings should be modified to reflect the range of abilities among older pedestrians. (*Am J Public Health.* 1997;87:393–397)



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## Introduction

For most older persons, especially those living in urban settings, maintaining the ability to cross the street safely is fundamental to remaining independent. Although the elderly have the highest rates of pedestrian death[1,2] and injury when adjustment is made for exposure,[3] little is known about the problems and abilities of older pedestrians. Recent studies of older people crossing the street,[4–8] most of which examined a single urban intersection,[5–8] are limited by their lack of generalizability to the broader population and their inability to examine in detail the health status of these pedestrians. Although it has been hypothesized that the walking speed of most elders may be too slow to cross streets safely in the time typically allotted at signalized intersections,[5,6] to our knowledge no population-based studies have specifically addressed this issue.

Using data from an urban community of the Established Populations for Epidemiologic Studies of the Elderly, we examined the health characteristics and abilities of older persons at risk for pedestrian injury—those who report that they have difficulty crossing the street.

## Methods

### *Study Population*

This study used data from an urban community of the Established Populations for Epidemiologic Studies of the Elderly. Details of the study design and data collection methods have been published elsewhere.[9] Briefly, the Yale Health and Aging Project began in 1982 with a random sample of noninstitutionalized persons aged 65 years and older living in the city of New Haven, the third largest city in Connecticut, with a population of approximately 131 000 in 1980. The sample was stratified according to sex and type of housing: public housing for the elderly, private housing for the elderly, or general community residence. A total of 2812 persons, 82% of the target population, participated in the baseline interview. The participation rate was 95% or better for each of seven annual follow-up interviews. Vital status was known for all but 12 members of the New Haven cohort. The data presented herein are unweighted because the sampling weights apply only to the 1982 baseline data. Fifty-seven percent of the baseline sample was drawn from age-restricted housing units.

At the seventh follow-up, 1606 of the 1685 known survivors in New Haven, then aged 72 or older, participated in a


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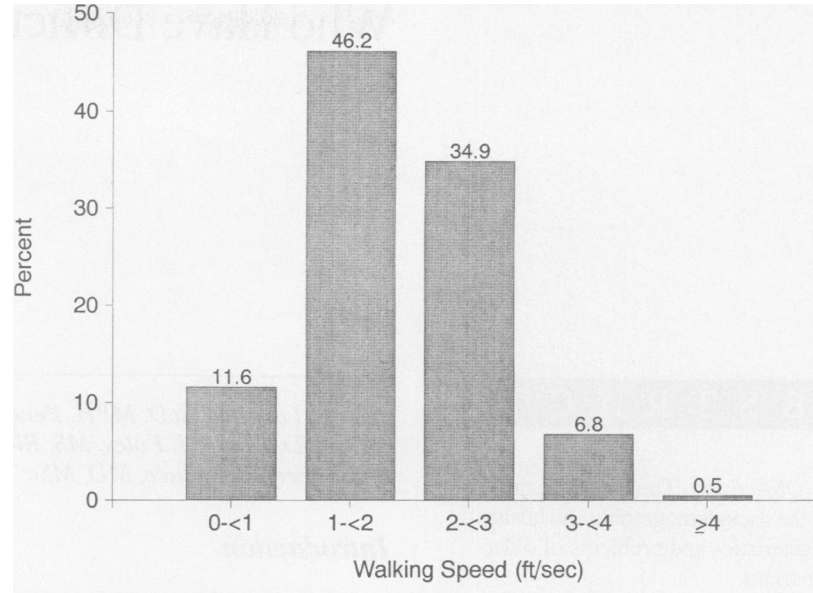
**Editor's Note.** See related editorial by Satariano (p 331) and comment by Kasl (p 333) in this issue.

**TABLE 1—Characteristics of the Study Population (n = 1249),[a] New Haven, Conn, 1989**

| | % |
|---|---|
| Age ≥80 y (range, 72–105) | 40.4 |
| Female | 62.8 |
| Public housing resident | 22.2 |
| No. ADLs requiring help[b] | |
| 0 | 89.1 |
| 1 or 2 | 7.9 |
| ≥3 | 3.0 |
| Unable to walk 1/2 mile | 42.5 |
| Unable to climb stairs | 21.8 |
| Drives a car | 35.5 |
| Has difficulty crossing the street | 11.4 |

[a]The study population excludes persons in nursing homes (n = 225), persons with missing information on residence or in hospital (n = 46), and persons interviewed by proxy (n = 86).
[b]Self-reported need for help from another person or from special equipment to perform one or more of the following activities of daily living (ADLs): bathing, dressing, getting from bed to chair, toileting, eating.




*Note.* Excludes four people who reported that they were unable to walk across a small room and eight people who answered "Don't know" regarding problems crossing the street. Three and 4 ft per second are equivalent to 0.92 m and 1.22 m per second, respectively.

**FIGURE 1—Distribution of walking speed of pedestrians aged 72 and older, New Haven, Conn, 1989 (n = 989).**

25-minute telephone interview conducted between May and December 1989. After exclusion of persons in nursing homes (n = 225), those in hospital or with missing information on residence (n = 46), and those with proxy interviews (n = 86), data from 1249 participants were available for analysis.

### *Study Variables*

The seventh (telephone) follow-up interview included questions about transportation issues and health status. Participants were asked, "When walking, do you have any problems crossing the street?" "Is it because (of) . . . You do not have time to get across? Cars making right turns? Any other reason?" "Do you need help crossing the street?" They were also asked about their driving status. The presence of chronic conditions was determined by asking participants if they had been told by a doctor that they had had a stroke, hip or other fracture, heart attack, cancer, or diabetes. For each of the disease variables, we combined the responses from the baseline and all seven follow-up interviews to determine the respondent's history of ever having been told by a doctor that he or she had the condition. A participant was determined to have limitation in activities of daily living if he or she needed help from another person or from special equipment or was unable to perform one or more of the following: bathing, dressing, getting from a bed to a chair, toileting, and eating.

Additional data from the sixth (in-person) follow-up, conducted in 1988 and 1989, included measured visual acuity, walking speed, and cognitive status. Distant (best corrected) vision was examined in both eyes together, using directional E's placed 4 m from the participant.[10] Participants with visual acuity of less than 20/40 were considered visually impaired. Participants with three or more errors on the Short Portable Mental Status Questionnaire[11] were classified as having a low mental status score.

Walking speed was assessed on an 8-ft (2.4-m) course. From a standing position, participants were instructed to walk to the other end of the course, continuing past the 8-ft mark, at their usual speed. They could use assistive devices if needed, and each participant was timed for two walks. The faster of the two speeds is presented here.

Approximately 20% of participants were missing data on walking speed. Persons with missing walking speeds were more likely to need help in one or more activities of daily living ($P = .001$) and to be aged 80 years or older ($P = .003$). Approximately 14% were missing the vision score and 9% were missing the mental status score. Participants with missing vision scores were not significantly different from the other participants; those with missing mental status scores tended to be older ($P = .06$). Fewer than 1% of participants were missing data for any of the remaining variables.

### *Statistical Methods*

All analyses were conducted with SAS software (SAS Institute Inc, Cary, NC). Means and percentages were compared by means of Student's *t* test and the chi-square test, respectively. Age- and sex-adjusted percentages were compared with SAS PROC GLM. Multivariable models were calculated by multiple logistic regression methods. Since functional impairments are the result of chronic conditions and thus are on the causal pathway from disease to difficulty crossing the street, we calculated separate models for measures of function and chronic conditions. For specific analyses of pedestrian characteristics, we limited the study population to the people most likely to be pedestrians by excluding those who reported that they were unable to

walk across a small room and those responding "Don't know" to the question about difficulty crossing the street.

## Results

The characteristics of study participants are shown in Table 1. They ranged in age from 72 to 105 years (mean age: 79.2). Twenty-two percent lived in public housing. Approximately 11% reported the need for help in one or more activity of daily living.

Overall, 11.4% of the New Haven residents reported difficulty crossing the street. The percentage of persons reporting difficulty increased from ages 72 through 79 to age 80 and older for both men (7.0% vs 10.5%) and women (8.6% vs 19.2%). Regarding specific pedestrian problems among persons reporting that they had difficulty crossing the street, 81% reported insufficient time to cross, 63% reported difficulty with right-turning vehicles, 78% said they needed help to cross, and 9% reported some other difficulty.

Figure 1 shows the distribution of walking speeds of New Haven pedestrians aged 72 years and older. Fewer than 1% (5 of 989) had a normal walking speed of at least 1.22 m (4 ft) per second, the speed generally required to cross an intersection from curb to curb in the time allotted at signalized intersections (Peter Mrowka, New Haven Traffic and Parking Department, personal communication, August 1995). Approximately 7% of older New Haven pedestrians had a normal walking speed of at least 0.92 m (3 ft) per second, the crossing speed at which New Haven signals are set at intersections in areas with large numbers of older persons (Peter Mrowka, personal communication, August 1995) (Figure 1).

Table 2 shows the health and physical function characteristics of pedestrians aged 72 and older in New Haven. Those reporting difficulty crossing the street had a significantly slower mean walking speed, poorer vision, lower mental status scores, and a greater need for help in activities of daily living. They were also more likely to have histories of stroke, fracture (excluding hip), and diabetes and to live in public housing. Persons reporting difficulty crossing the street were more than eight times as likely as others to report that they got out and away from the house less than once per month.

Table 3 shows the risk factors independently associated with reported difficulty crossing the street from among the significant factors in Table 2 (frequency of going out was not included in these models). In the logistic regression model assessing factors related to function, slower walking speed and need for help in activities of daily living were associated with self-reported difficulty crossing the street. Impaired vision and low mental status score were strongly correlated with walking speed and need for help in activities of daily living; they were not independently associated with difficulty crossing the street when either of these factors was added to the model. In the model assessing disease factors, his-

**TABLE 2—Characteristics of Pedestrians Aged 72 and Older (n = 1231),[a] by Self-Reported Difficulty Crossing the Street, New Haven, Conn, 1989**

| Characteristic | Difficulty Crossing the Street: Yes (n = 141) | Difficulty Crossing the Street: No (n = 1090) | P |
|---|---|---|---|
| Mean walking speed, m/sec (SD) | 0.38 (0.18) | 0.59 (0.22) | <.001 |
| Walking speed ≤0.41, m/sec[b,c] | 58.0 | 25.4 | <.001 |
| Visual acuity <20/40 [b] | 31.5 | 20.2 | .004 |
| Low mental status score[b,d] | 30.3 | 17.1 | <.001 |
| Needs help in one or more ADL[e] | 47.9 | 6.1 | <.001 |
| History of stroke | 21.4 | 7.8 | <.001 |
| History of fracture (excluding hip) | 39.2 | 28.0 | .007 |
| History of hip fracture | 7.0 | 4.8 | .268 |
| History of heart disease | 23.0 | 17.4 | .103 |
| History of cancer | 24.0 | 20.2 | .306 |
| History of diabetes | 28.9 | 15.8 | <.001 |
| Public housing resident | 33.0 | 20.5 | <.001 |
| Gets out of the house <1 time/month | 23.1 | 2.8 | <.001 |

*Note.* Except for walking speed, all figures shown are percentages.
[a]This number excludes 5 people who reported that they were unable to walk across a small room and 13 people who answered "Don't know" regarding problems crossing the street.
[b]Measured in 1988/89.
[c]Lowest quartile of performance.
[d]Three or more errors on the Short Portable Mental Status Questionnaire.[11]
[e]Self-reported need for help from another person or from special equipment to perform one or more of the following activities of daily living (ADLs): bathing, dressing, getting from bed to chair, toileting, eating.

**TABLE 3—Risk Factors Independently Associated with Self-Reported Difficulty Crossing the Street among Pedestrians Aged 72 and Older (n = 980),[a] New Haven, Conn, 1989**

| | Odds Ratio | 95% Confidence Interval |
|---|---|---|
| Function model[b] | | |
| Walking speed ≤0.41 m/sec[c,d] | 2.8 | 1.7, 4.6 |
| Needs help with ≥1 ADL | 10.7 | 6.2, 18.5 |
| Chronic conditions model[e] | | |
| History of stroke | 2.7 | 1.7, 4.4 |
| History of fracture (excluding hip) | 1.6 | 1.1, 2.4 |
| History of diabetes | 1.9 | 1.3, 3.0 |

*Note.* ADL = activities of daily living.
[a]This number excludes 4 people who reported that they were unable to walk across a small room, 8 people who answered "Don't know" regarding problems crossing the street, 248 people for whom walking speed was missing, and 9 people for whom data were missing for one or more of the remaining variables.
[b]From a multiple logistic regression model adjusted for age, sex, type of housing, vision, and mental status score.
[c]Measured in 1988/89.
[d]Lowest quartile of performance.
[e]From a multiple logistic regression model adjusted for age, sex, type of housing, history of hip fracture, heart disease, and cancer.

tory of stroke, history of fracture (excluding hip), and history of diabetes were all independently associated with difficulty crossing the street.

## Discussion

Approximately 11% of New Haven residents aged 72 or older, including nearly 20% of women aged 80 or older, reported difficulty crossing the street. Older New Haven pedestrians needing help in one or more activities of daily living were 10 times as likely as others, and those with the slowest walking speeds were nearly 3 times as likely as others, to report difficulty crossing the street. Stroke was the medical condition most strongly associated with difficulty crossing the street. Overall, fewer than 1% of older pedestrians had a normal walking speed sufficient to cross the street in the time typically allotted.

Not surprisingly, slow walking speed was strongly associated with difficulty crossing the street. The finding that 99% or more of the New Haven pedestrians aged 72 or older had a walking speed of less than 1.22 m/sec, the speed typically required to cross in the time allotted at signalized intersections,[12] is similar to the findings of previous US studies. Hoxie and Rubenstein found that 96% of the persons aged 65 or older crossing at a Los Angeles intersection had a walking speed slower than 1.22 m/sec.[6] Guralnik et al. found that approximately 99% of the 5097 persons aged 71 or older from three communities—New Haven, Conn; rural Iowa; and East Boston, Mass—had a normal walking speed of less than 1.22 m/sec.[13] Even the more moderate walking speed of 0.92 m/sec, the speed at which New Haven signals are set at intersections in areas with large numbers of older persons, exceeded the walking speed of approximately 93% of New Haven pedestrians aged 72 or older.

Although nearly all of the older New Haven residents in our study had walking speeds less than that required to cross the street in the time typically allotted at signalized intersections,[12] a much lower percentage reported difficulty crossing the street. At least two factors may contribute to this difference. First, there are certain limitations in the walking speed estimates used in these analyses. Walking speed in a controlled test over a short course of 8 ft is strongly influenced by initial start-up time and underestimates walking speed over a longer distance. Normal walking speed in a test situation also may not represent the speed an individual would choose when faced with crossing a street, and it certainly does not represent the maximum speed that might be reached in a situation perceived as potentially hazardous. Even when instructed to cross an intersection at a fast speed, however, approximately 60% of a sample of Swedish pedestrians aged 70 or older achieved a walking speed of less than 1.22 m/sec.[14] Second, although we excluded people who do not walk, we may have included some who cross so infrequently that they are not aware of any difficulty, some who elect to cross only at easy locations or at times when there is little traffic, and others who may avoid crossing the street altogether.

The need for help from another person or from special equipment in one or more activity of daily living was the factor most strongly independently associated with report of difficulty crossing the street. The independent association of the need for help in these activities with difficulty crossing the street, even after controlling for walking speed, suggests that disability in activities of daily living likely measures mobility problems relevant to crossing the street that were not captured by the walking speed variable used in this analysis. The strong correlation between the need for help in activities of daily living and both impaired vision and low mental status scores suggests that the need for help in activities of daily living is an indicator of a combination of problems that contribute to difficulty crossing the street among older pedestrians. Walking speed also was correlated with both vision and mental status.

Visual impairments in combination with the demands of the urban crossing environment frequently pose significant problems for older pedestrians. Retting found that visual impairment among the elderly attempting to cross a wide boulevard in New York City resulted in an inability to distinguish between the "Walk" and "Don't Walk" signs from across the street and an inability to determine the boundary between the curb and street, resulting in some pedestrians' stepping off the curb and into the path of oncoming vehicles.[8] In our study, nearly one third of the older New Haven pedestrians reporting difficulty crossing the street had impaired vision.

Our study has some limitations. First, the study population included only persons aged 72 or older and our results may not apply to the younger elderly. Second, we focused our analyses on the subgroup of older persons at greatest risk for pedestrian injury, those living in an urban environment. Third, difficulty crossing the street was determined only by self-report. Finally, we lacked data on the injury experience of elderly pedestrians, detailed information on specific problems they encountered, and the consequences of difficulty crossing the street (e.g., avoidance of crossing, need for help in shopping). Changes in exposure to risk with increasing age and disability also were not addressed by our study. In an Australian survey, older people reported increased pedestrian activity because they were driving less.[15] Future studies should address this issue.

Some interventions focused on pedestrians are suggested by our findings. Physicians may help decrease pedestrian problems among their patients by reducing the impact of disability. Visual problems should be corrected and walking aids, when needed, should be properly prescribed. Some older persons may benefit from specific interventions to improve gait. Recent studies have shown that the walking speed of older persons can be increased by targeted exercise programs.[16–19]

Passive interventions that create a safer environment are most likely to be effective for preventing injuries.[20] Improvements in older pedestrians' safety can best be achieved through combined interventions involving reduced traffic speeds,[8] increased use of median strips or traffic islands in roadway design, and increased crossing times.[4,8] Our findings support those from a recent Federal Highway Administration–sponsored study that recommends that crossing times at signalized intersections in areas with large populations of elders be extended to accommodate walking speeds of 0.9 m (3 ft) per second or less.[4] The walking speed of 1.22 m/sec generally used to set crossing signals in North American cities is based on studies of healthy older persons without mobility problems[5]; however, the majority of persons older than age 70 have normal walking speeds that may be insufficient to cross safely. Thus, the recommended walking speed and the corresponding timing of traffic lights in areas with large numbers of older persons should be modified to reflect the range of abilities among older pedestrians.

Interventions to improve the safety of older pedestrians have been shown to substantially reduce traffic-related deaths[7,8] and increase the independence and well-being of the urban elderly. Implementation of these interventions, however, is not

widespread. With the aging of the US population, further attention must be paid to this important public health problem. □

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